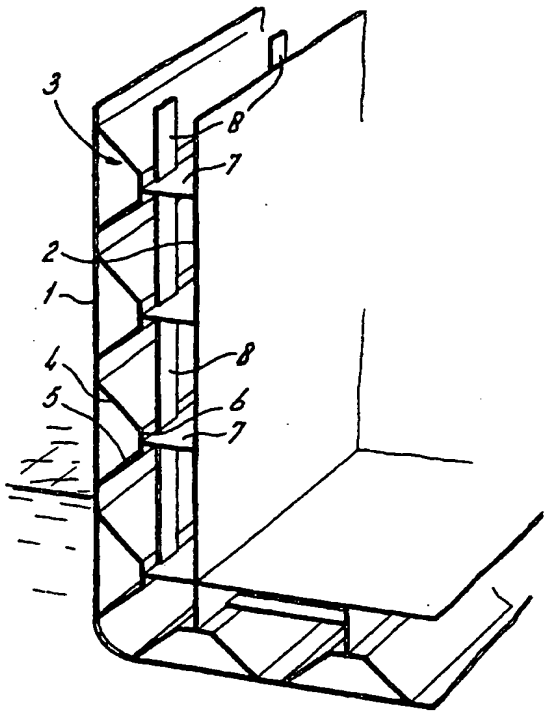


PCTWORLD INTELLECTUAL PROPERTY ORGANIZATION
International Bureau

INTERNATIONAL APPLICATION PUBLISHED UNDER THE PATENT COOPERATION TREATY (PCT)

(51) International Patent Classification ⁷ : B63B 43/18, 3/20, 3/62, E04C 2/34	A1	(11) International Publication Number: WO 00/35746 (43) International Publication Date: 22 June 2000 (22.06.00)
(21) International Application Number: PCT/NL99/00757 (22) International Filing Date: 10 December 1999 (10.12.99) (30) Priority Data: 1010794 11 December 1998 (11.12.98) NL (71) Applicant (for all designated States except US): SCHELDE MARITIEM B.V. [NL/NL]; P.O. Box 555, NL-4380 AN Vlissingen (NL). (72) Inventor; and (75) Inventor/Applicant (for US only): LUDOLPHIJ, Johannes, Wilhelmus, Lubertus [NL/NL]; Luzacstraat 7, NL-4384 EW Vlissingen (NL). (74) Agent: DE BRUIJN, Leendert, C.; Nederlandsch Octrooibureau, Scheveningseweg 82, P.O. Box 29720, NL-2502 LS The Hague (NL).		(81) Designated States: AE, AL, AM, AT, AU, AZ, BA, BB, BG, BR, BY, CA, CH, CN, CR, CU, CZ, DE, DK, DM, EE, ES, FI, GB, GD, GE, GH, GM, HR, HU, ID, IL, IN, IS, JP, KE, KG, KP, KR, KZ, LC, LK, LR, LS, LT, LU, LV, MA, MD, MG, MK, MN, MW, MX, NO, NZ, PL, PT, RO, RU, SD, SE, SG, SI, SK, SL, TJ, TM, TR, TT, TZ, UA, UG, US, UZ, VN, YU, ZA, ZW, ARIPO patent (GH, GM, KE, LS, MW, SD, SL, SZ, TZ, UG, ZW), Eurasian patent (AM, AZ, BY, KG, KZ, MD, RU, TJ, TM), European patent (AT, BE, CH, CY, DE, DK, ES, FI, FR, GB, GR, IE, IT, LU, MC, NL, PT, SE), OAPI patent (BF, BJ, CF, CG, CI, CM, GA, GN, GW, ML, MR, NE, SN, TD, TG). Published <i>With international search report.</i> <i>Before the expiration of the time limit for amending the claims and to be republished in the event of the receipt of amendments.</i>
(54) Title: COLLISION-RESISTANT DOUBLE-SKIN STRUCTURE (57) Abstract <p>An impact-resistant double-skinned structure, such as a double-skinned ship's side, comprises an outer skin (1) and an inner skin (2). A series of channels (3) made of a ductile material and positioned alongside or above one another are attached by the tips of their side walls (4, 5) to the inner surface of the outer skin (1) of the structure. The base (6) of each channel is connected at least by a stringer (7), essentially perpendicular to said base, to the inner skin (1) of the structure or a construction attached thereto.</p> 		

FOR THE PURPOSES OF INFORMATION ONLY

Codes used to identify States party to the PCT on the front pages of pamphlets publishing international applications under the PCT.

AL	Albania	ES	Spain	LS	Lesotho	SI	Slovenia
AM	Armenia	FI	Finland	LT	Lithuania	SK	Slovakia
AT	Austria	FR	France	LU	Luxembourg	SN	Senegal
AU	Australia	GA	Gabon	LV	Latvia	SZ	Swaziland
AZ	Azerbaijan	GB	United Kingdom	MC	Monaco	TD	Chad
BA	Bosnia and Herzegovina	GE	Georgia	MD	Republic of Moldova	TG	Togo
BB	Barbados	GH	Ghana	MG	Madagascar	TJ	Tajikistan
BE	Belgium	GN	Guinea	MK	The former Yugoslav Republic of Macedonia	TM	Turkmenistan
BF	Burkina Faso	GR	Greece	ML	Mali	TR	Turkey
BG	Bulgaria	HU	Hungary	MN	Mongolia	TT	Trinidad and Tobago
BJ	Benin	IE	Ireland	MR	Mauritania	UA	Ukraine
BR	Brazil	IL	Israel	MW	Malawi	UG	Uganda
BY	Belarus	IS	Iceland	MX	Mexico	US	United States of America
CA	Canada	IT	Italy	NE	Niger	UZ	Uzbekistan
CF	Central African Republic	JP	Japan	NL	Netherlands	VN	Viet Nam
CG	Congo	KE	Kenya	NO	Norway	YU	Yugoslavia
CH	Switzerland	KG	Kyrgyzstan	NZ	New Zealand	ZW	Zimbabwe
CI	Côte d'Ivoire	KP	Democratic People's Republic of Korea	PL	Poland		
CM	Cameroon	KR	Republic of Korea	PT	Portugal		
CN	China	KZ	Kazakhstan	RO	Romania		
CU	Cuba	LC	Saint Lucia	RU	Russian Federation		
CZ	Czech Republic	LI	Liechtenstein	SD	Sudan		
DE	Germany	LK	Sri Lanka	SE	Sweden		
DK	Denmark	LR	Liberia	SG	Singapore		
EE	Estonia						

Title: Collision-resistant double-skin structure

The invention relates to a collision-resistant double-skin structure, such as a double-skinned ship's side.

5

If oil tankers are involved in collisions or run aground this can result in severe pollution of the environment if the hull is holed. The same applies in respect of chemical tankers on inland waterways. Existing ferries run the risk of being holed in the side in the event of a collision, which under certain circumstances gives rise to an appreciable safety risk for the passengers. It is thus apparent that improvement in the impact and explosion resistance of double-skinned structures of ships, offshore installations and facilities for the processing industry is extremely important.

10

The aim of the invention is to provide a substantially improved collision- and explosion-resistant double-skinned structure. According to the invention, to this end the structure comprises:

15

a series of channels made of a ductile material and positioned alongside or above one another, which channels are attached by the tips of their side walls to the inner surface of the outer skin of the structure, the base of each channel being connected at least by a stringer, essentially perpendicular to said base, to the inner skin of the structure or to a construction attached thereto.

20

The substantially improved resistance to holing is achieved in that in the event of a collision the dent manifests itself over a substantial width, the ideal membrane stress being achieved and the resistance to holing being maximum.

25

An even better result is achieved if the bases of successive channels are joined to one another by means of strips or a stringer. The strips or the stringer provide for symmetrical deformation of both side walls of the channels at the start of the collision. The strips or the stringer then break off. Should the strips or the stringer not be present there is a risk in a collision of one of the side walls of the channels being deflected substantially to one side and the other side wall following the first side wall. This non-symmetrical displacement of the side walls of the channels leads to a reduction in the resistance to holing.

30

The intention is that those channel parts or side walls directed towards the inner surface of the outer skin of the ship's side make an angle α of less than 90° with said outer skin.

- 5 Individual channels can be used. Instead of this the channels can also be joined to one another to form a single corrugated plate.

In the case of a particular structure, channels are also arranged on the inner surface of the inner skin, which channels are attached by the tips of the side walls to said inner surface, and
10 the said stringers extend between the channels arranged on the outer skin and the channels arranged on the inner skin.

The material of the structure must be ductile. Steel 37 proves to be an excellent material, but some plastics and materials which have a so-called collapse path, such as certain composites
15 and sandwich materials, can also be processed.

The invention will now be explained on the basis of the description of the figures.

Figure 1 shows a perspective view of part of a double-skinned ship's side according to a first
20 embodiment of the invention.

Figure 2 shows a vertical section of the ship's side according to Figure 1.

Figure 3 shows a vertical section of the ship's side according to Figure 1 after a severe
25 collision.

Figure 4 shows a vertical section of a second embodiment of a ship's side.

Figure 5 shows a vertical section of a third embodiment of a ship's side.
30

The double-skinned structure shown in Figures 1 and 2 comprises an outer skin 1 and an inner skin 2. Channels 3 are attached to the inner surface of the outer skin 1. The channels have two side walls 4, 5, which make an angle of 45° with the outer skin 1, and a base 6,

which joins the two side walls 4 and 5 to one another. A stringer 7 extends from the base 6 of the channels, perpendicularly to said base, to the inner surface of the inner skin 2. The bases 6 of the successive channels are joined to one another by strips 8. The material of said parts 1 to 8 is ductile and consists, for example, of steel 37.

5

Figure 3 shows the case where a section of double-skinned ship's side according to Figures 1 and 2 has been subjected to a severe collision. The outer skin 1 has moved somewhat inwards and the side walls 4 and 5 of the channel have been bent. The stringer 7 has become curved. No holes are produced during the collision. In fact, there is question of a membrane stress.

10

In the embodiment according to Figure 4 the channels are of semi-cylindrical construction.

15

Figure 5 shows an embodiment in which channels 3 are attached both to the inner surface of the outer skin and to the inner surface of the inner skin and the stringers 7 extend between the bases of the channels positioned opposite one another.

20

The structure according to the invention employed in a ship having a double-skinned hull has now been tested and the result was astonishing. The energy absorbed by the structure in a severe collision with a ram ship was found to be so effective that the outer skin exhibited shallow denting over a large surface (this skin behaved as a membrane) and there was no holing.

Claims

1. Collision-resistant double-skinned structure having an outer skin and an inner skin, comprising:
 - 5 a series of channels (3) made of a ductile material and positioned alongside or above one another, which channels are attached by the tips of their side walls (4, 5) to the inner surface of the outer skin (1) of the structure, the base (6) of each channel being connected at least by a stringer (7), essentially perpendicular to said base, to the inner skin of the structure or to a construction attached thereto.
- 10 2. Structure according to Claim 1, characterised in that the bases (6) of successive channels are joined to one another by means of strips (8) or a stringer.
- 15 3. Structure according to Claim 1 or 2, characterised in that those channel parts (4, 5) directed towards the inner surface of the outer skin of the ship's side make an angle α of less than 90° with said outer skin.
- 20 4. Structure according to one of the preceding claims, characterised in that channels (3) are also arranged on the inner surface of the inner skin (2), which channels (3) are attached by the tips of the side walls to said inner surface, and in that the said stringers (7) extend between the channels (3) arranged on the outer skin (1) and the channels (3) arranged on the inner skin (2).
- 25 5. Structure according to one of the preceding claims, characterised in that the channels (3) of each series are joined to one another to form a corrugated plate.
6. Structure according to one of the preceding claims, characterised in that the structure is made of steel 37.

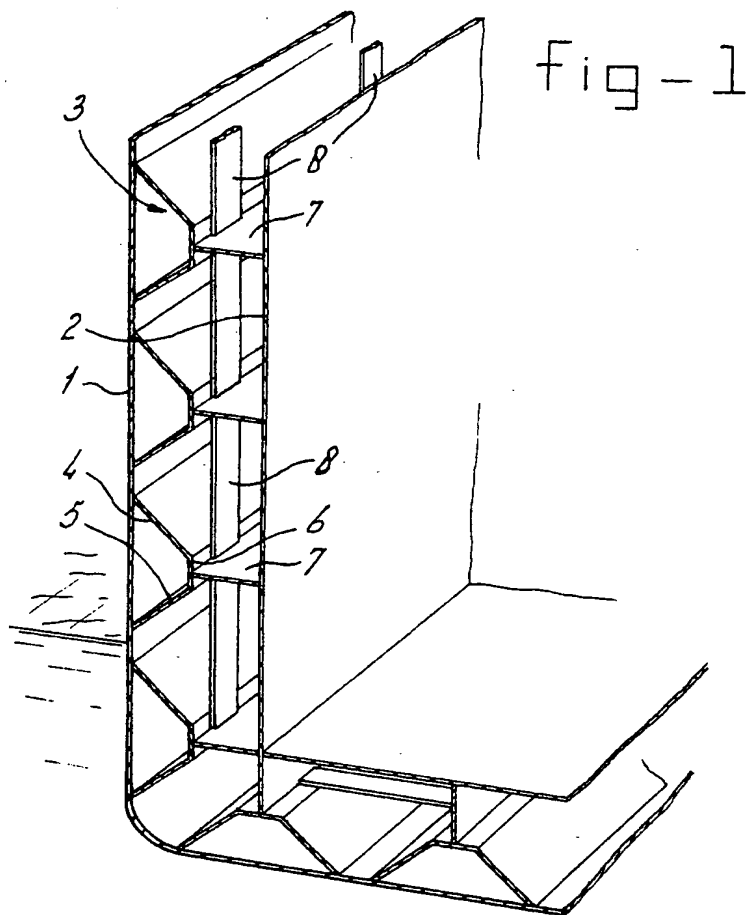


fig-2

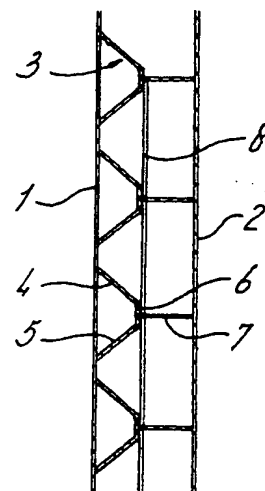


fig-3

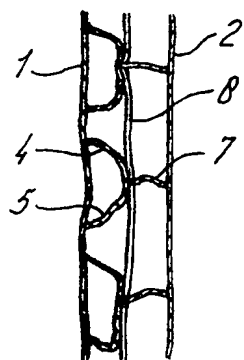


fig-4

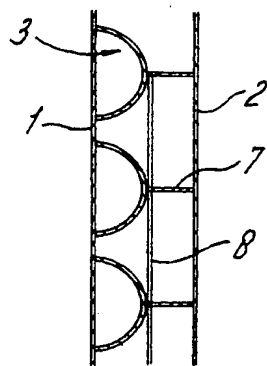
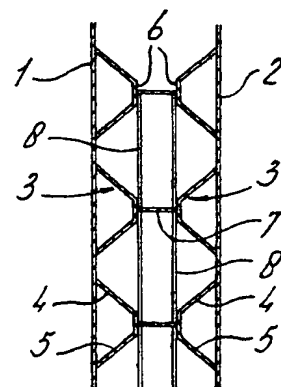


fig-5



INTERNATIONAL SEARCH REPORT

Inter. Appl. No.
PCT/NL 99/00757

A. CLASSIFICATION OF SUBJECT MATTER

IPC 7 B63B43/18 B63B3/20 B63B3/62 E04C2/34

According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)

IPC 7 B63B E04C F41H F42D B32B

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

Electronic data base consulted during the international search (name of data base and, where practical, search terms used)

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category *	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
A	EP 0 799 764 A (SCHELDE MARITIEM B V) 8 October 1997 (1997-10-08) figures 1-3 column 1, line 3 - line 13 column 2, line 31 - line 48	1-5
A	WO 92 10396 A (STUART WILLIAM) 25 June 1992 (1992-06-25) claim 26; figures 3-7	1,3,6
A	GB 10405 A A.D. 1912 (JONES THOMAS T) 17 October 1912 (1912-10-17) figures 1,1A page 1, line 4 - line 8 page 3, line 21 - line 36 page 3, line 56 -page 4, line 4	1,2
-/-		

☒ Further documents are listed in the continuation of box C.

☒ Patent family members are listed in annex.

* Special categories of cited documents:

"A" document defining the general state of the art which is not considered to be of particular relevance

"E" earlier document but published on or after the international filing date

"L" document which may throw doubts on priority claim(s) or which is cited to establish the publication date of another citation or other special reason (as specified)

"O" document referring to an oral disclosure, use, exhibition or other means

"P" document published prior to the international filing date but later than the priority date claimed

"T" later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention

"X" document of particular relevance; the claimed invention cannot be considered novel or cannot be considered to involve an inventive step when the document is taken alone

"Y" document of particular relevance; the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art.

"&" document member of the same patent family

Date of the actual completion of the international search

4 April 2000

Date of mailing of the international search report

12/04/2000

Name and mailing address of the ISA

European Patent Office, P.B. 5818 Patentlaan 2
NL - 2280 HV Rijswijk
Tel. (+31-70) 340-2040, Tx. 31 651 epo nl,
Fax (+31-70) 340-3018

Authorized officer

Häusler, F.U.

INTERNATIONAL SEARCH REPORT

International Application No
PCT/NL 99/00757

C.(Continuation) DOCUMENTS CONSIDERED TO BE RELEVANT		
Category *	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
A	US 4 530 197 A (RAINVILLE GILLES) 23 July 1985 (1985-07-23) figures 1-3 column 3, line 62 -column 4, line 16 column 4, line 35 - line 57	1, 3-5
A	FR 2 276 437 A (MERA-ZSM ZAKLADY SYSTEMOW MINIKOMPUTEROWYCH IM. JANKA KRASICKIEGO) 23 January 1976 (1976-01-23) claim 1; figures 1,2	1-5
A	US 5 379 711 A (FISCHER EUGENE C ET AL) 10 January 1995 (1995-01-10) abstract; figures 1,5	1
A	US 2 405 590 A (MASON WARREN P) 13 August 1946 (1946-08-13)	
A	US 5 061 541 A (GERTEL MAURICE) 29 October 1991 (1991-10-29)	

INTERNATIONAL SEARCH REPORT

information on patent family members

International Application No
PCT/NL 99/00757

Patent document cited in search report		Publication date	Patent family member(s)	Publication date
EP 0799764	A	08-10-1997	NL 1002756 C	02-10-1997
WO 9210396	A	25-06-1992	AU 8943691 A	08-07-1992
			DE 69127204 D	11-09-1997
			EP 0559806 A	15-09-1993
			PL 171567 B	30-05-1997
			US 5477797 A	26-12-1995
GB M10405	A		NONE	
US 4530197	A	23-07-1985	DE 3485872 A	24-09-1992
			EP 0130583 A	09-01-1985
FR 2276437	A	23-01-1976	NL 7507152 A	30-12-1975
US 5379711	A	10-01-1995	NONE	
US 2405590	A	13-08-1946	NONE	
US 5061541	A	29-10-1991	NONE	